

What is claimed:

1 **1.** Apparatus for optically switching light from an input array comprising a
2 plurality of light sources to an output array comprising a plurality of light receivers;
3 wherein said apparatus is adapted to allow light from any selected light source to be
4 switched to any selected light receiver; and wherein said apparatus is adapted to allow
5 light from any or all of the light sources to be thus switched independently and
6 simultaneously; and wherein said apparatus is adapted to allow each of the light
7 receivers thus to receive light from zero, one, several, or all of the light sources; said
8 apparatus comprising:

9 **(a)** a series of input polarization-dependent angular deflectors, wherein the
10 angle by which each of said input deflectors deflects incident light is a function
11 of the direction of polarization of the light incident on said deflector;

12 **(b)** an array of input polarization control elements associated with each said
13 input deflector, wherein each said input array comprises one input polarization
14 control element corresponding to each light source, and wherein each said input
15 polarization control element controls the degree, if any, to which the direction
16 of polarization of light transmitted through said input polarization control element
17 is altered;

18 wherein:

19 **(c)** said input polarization control arrays and said input deflectors are positioned
20 so that the first said input polarization control array is adapted to transmit light
21 from the light sources through said input polarization control elements of the first
22 said input polarization control array to the first said input deflector; and so that

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23 each subsequent said input polarization control array is adapted to transmit light
24 from the preceding said input deflector through said input polarization control
25 elements of said subsequent input polarization control array to said input
26 deflector associated with said subsequent input polarization control array; and
27 so that the last of said input deflectors is adapted to transmit light to the light
28 receivers;

29 and wherein:

30 (d) said apparatus is adapted to allow the switching of light from any selected
31 light source to any selected receiver, by using the input controllers to control the
32 direction of polarization of the light from the selected light source imposed by
33 said input polarization control elements as the light enters each of said input
34 deflectors, so that the net direction of the deflection of the light caused by all
35 said input deflectors, which is a function of the directions of polarization of the
36 light as it passes through each of said input deflectors, causes the light to be
37 directed to the selected receiver.

1 2. Apparatus as recited in Claim 1, additionally comprising:

2 (a) a series of output polarization-dependent angular deflectors, wherein the
3 angle by which each of said output deflectors deflects incident light is a function
4 of the direction of polarization of the incident light;

5 (b) an array of output polarization control elements associated with each said
6 output deflector, wherein each said output array comprises one output
7 polarization control element corresponding to each light receiver, and wherein
8 each said output polarization control element controls the degree, if any, to
9 which the direction of polarization of light transmitted through said output
10 polarization control element is altered;

11 wherein:

12 (c) said output polarization control arrays and said output deflectors are
13 positioned so that the first said output polarization control array is adapted to
14 transmit light from the last said input deflector through said output polarization
15 control elements of the first said output polarization control array to the first said
16 output deflector; and so that each subsequent said output polarization control
17 array is adapted to transmit light from the preceding said output deflector
18 through said output polarization control elements of said subsequent output
19 polarization control array to said output deflector associated with said
20 subsequent output polarization control array; and so that the last of said output
21 deflectors is adapted to transmit light to the light receivers.

1 **3.** Apparatus as recited in Claim 2, additionally comprising a first single lens
2 adapted to collimate or focus light exiting the last said input deflector, and a second
3 single lens adapted to focus light entering the first said output polarization control
4 array, so that light is focused as it impinges on the light receivers.

1 **4.** Apparatus as recited in Claim 2, wherein said series of output
2 polarization-dependent angular deflectors is substantially complementary to said series
3 of input polarization-dependent angular deflectors, and wherein said array of output
4 polarization control elements is substantially complementary to said array of input
5 polarization control elements.

1 **5.** Apparatus as recited in Claim 2, wherein said series of output
2 polarization-dependent angular deflectors is not substantially complementary to said
3 series of input polarization-dependent angular deflectors, or wherein said array of
4 output polarization control elements is not substantially complementary to said array
5 of input polarization control elements, or both.

1 **6.** Apparatus as recited in Claim 2, wherein said polarization control
2 elements are set so that light from two of the light sources is directed normally to one
3 of the light receivers, at polarizations that are orthogonal to one another.

1 **7.** Apparatus as recited in Claim 1, additionally comprising an input array
2 comprising a plurality of single mode optical fibers.

1 **8.** Apparatus as recited in Claim 1, additionally comprising an output array
2 comprising a plurality of single mode optical fibers.

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1 **9.** Apparatus as recited in Claim 1, wherein said polarization control
2 elements comprise twisted nematic liquid crystal cells.

1 **10.** Apparatus as recited in Claim 1, wherein said polarization control
2 elements comprise at least one Pockels cell.

1 **11.** Apparatus as recited in Claim 1, wherein said polarization control
2 elements comprise at least one Kerr cell.

1 **12.** Apparatus as recited in Claim 1, wherein said polarization control
2 elements comprise at least one ferroelectric liquid crystal cell.

1 **13.** Apparatus as recited in Claim 1, wherein said deflectors comprise
2 Wollaston prisms.

1 **14.** Apparatus as recited in Claim 1, wherein said deflectors comprise Rochon
2 prisms.

1 **15.** Apparatus as recited in Claim 1, wherein each of said deflectors
2 comprises a combination of a birefringent crystal and an optical path control; wherein
3 said optical path control is positioned in the paths of light exiting said crystal to deflect
4 light having different polarization in different directions; and wherein said optical path
5 control comprises one or more mirrors, one or more prisms, or one or more mirrors and
6 one or more prisms.

1 **16.** Apparatus as recited in Claim 1, wherein said apparatus is adapted to
2 switch light from an input array to an output array that are adjacent to one another.

1 **17.** A device comprising two apparatuses as recited in Claim 1, additionally
2 comprising a fast optical switch to direct light from the input array to a selected one of
3 said apparatuses.

1 **18.** A device as recited in Claim 17, wherein said fast optical switch
2 comprises a polarizer, a Pockels cell and a polarizing beam splitter; or wherein said
3 fast optical switch comprises a polarizer, a Kerr cell and a polarizing beam splitter; or
4 wherein said fast optical switch comprises a polarizer, a ferroelectric liquid crystal cell
5 and a polarizing beam splitter.

1 **19.** A device comprising two apparatuses as recited in Claim 1, wherein said
2 device is adapted to direct light from one input array to two output arrays.

1 **20.** Apparatus as recited in Claim 1, wherein the dimensions of said
2 deflectors, the spacings of said deflectors from one another, and the dimensions of
3 said polarization control elements are such that there is negligible crosstalk between
4 the light from any two light sources as the light traverses said apparatus, regardless
5 of the net direction of deflection imposed on the light from the two light sources by said
6 apparatus.

1 **21.** Apparatus as recited in Claim 1, wherein each said input deflector, other
2 than the first said input deflector, has an angular deflection about twice the angular
3 deflection of the preceding said input deflector.

1 **22.** Apparatus as recited in Claim 1, wherein said apparatus is adapted to
2 switch light from a one-dimensional input array to a one-dimensional output array.
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Table 1. Mean values of the variables used in the analysis